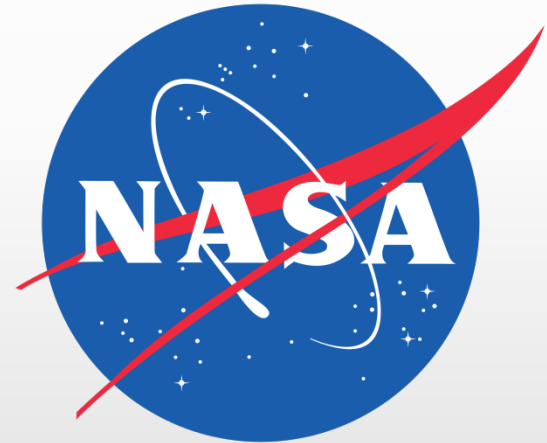


From México to NASA and the Roman Space Telescope

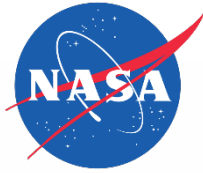
Margaret Z. Domínguez Ph.D.

Ambassador of

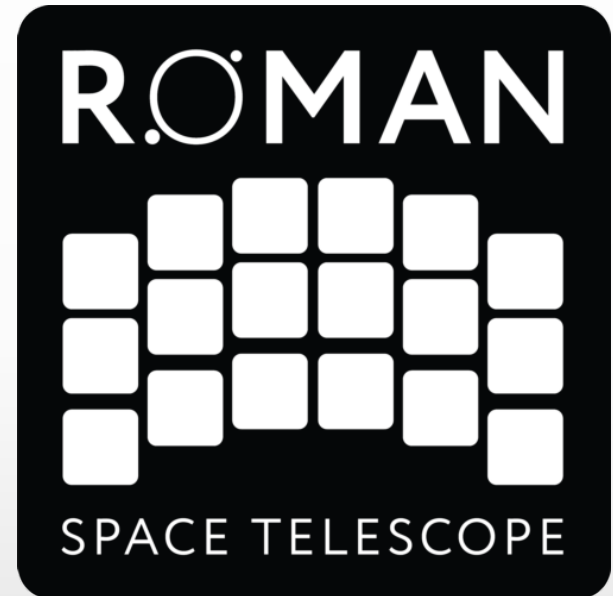


Instituto Nacional de Astrofísica, Óptica y Electrónica
Puebla, México on April 26, 2022

Outline



- Decadal survey missions
- Roman Space Telescope overview
- Roman's instruments
- Wide field instrument
- WFI Grism component and evolution
- Individual grism elements and their characterization
- Building the grism assembly
- Summary and current status



ASTROPHYSICS

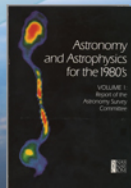
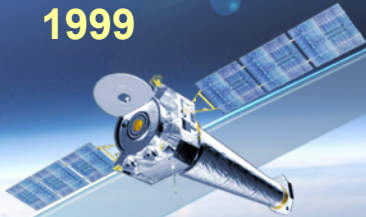
Decadal Survey Missions

1990



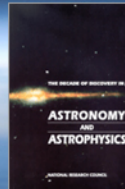
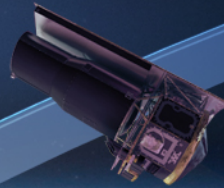
1972
Decadal Survey
Hubble

1999



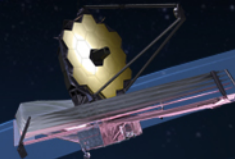
1982
Decadal Survey
Chandra

2003



1991
Decadal Survey
Spitzer

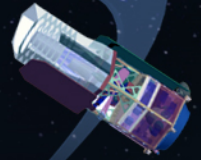
2021



2001
Decadal Survey
JWST, SOFIA



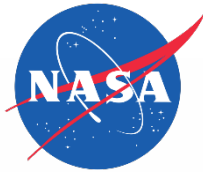
LD: 2020s



2010
Decadal Survey
WFIRST

Now
Nancy Grace Roman
Space Telescope

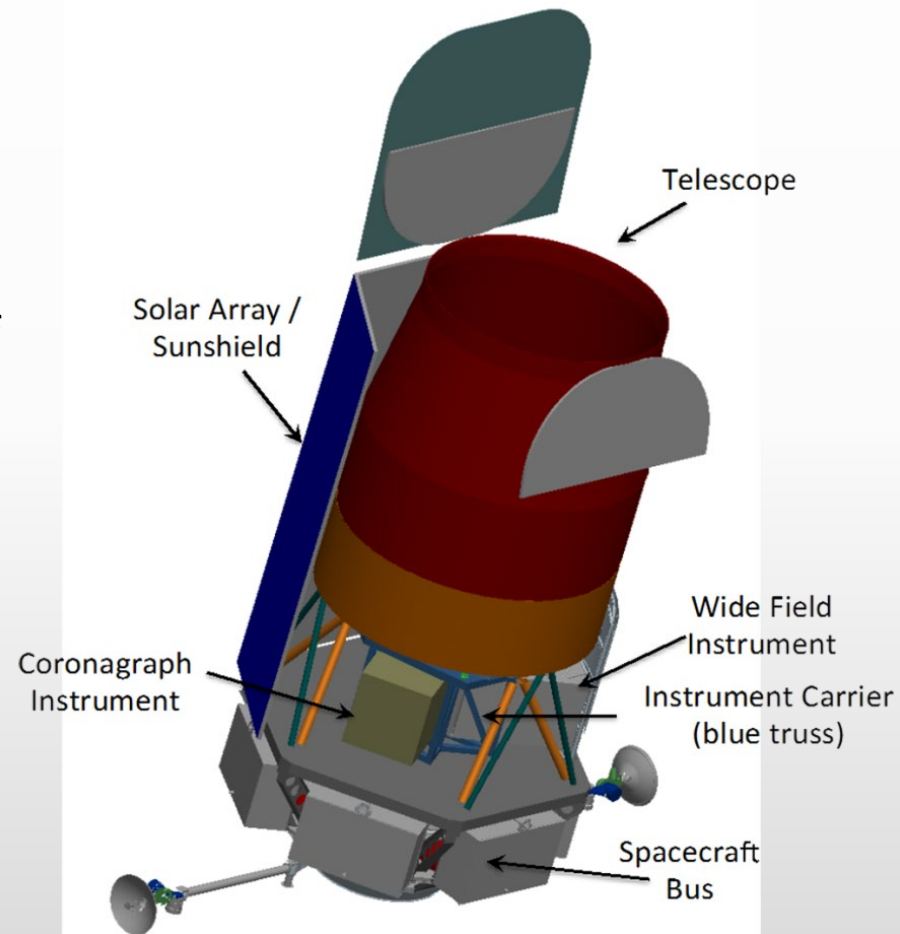
Nancy Grace Roman Space Telescope



Roman Space Telescope overview

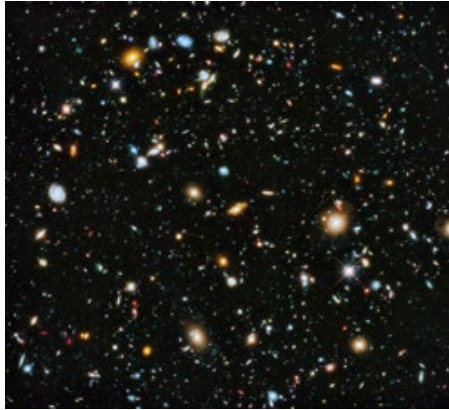
The Roman Space Telescope is a NASA observatory:

- 2.4m telescope.
- Is slated to launch in the mid-2020s.
- Will have a primary mission lifetime of 5 years, with a potential 5 year extended mission.
- Two instruments:
 - Wide Field Instrument
 - Coronagraph Instrument

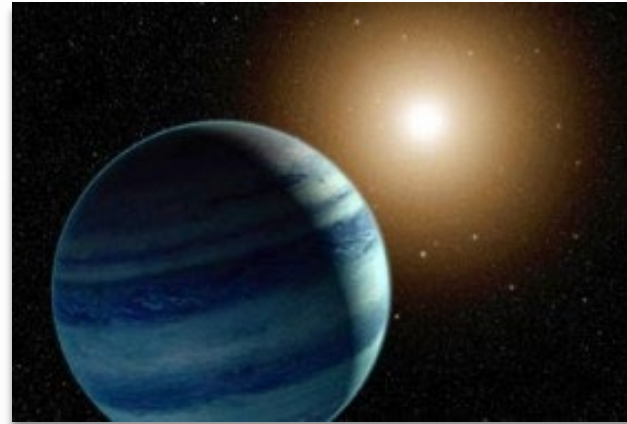


Roman Space Telescope Science Overview

Dark Energy

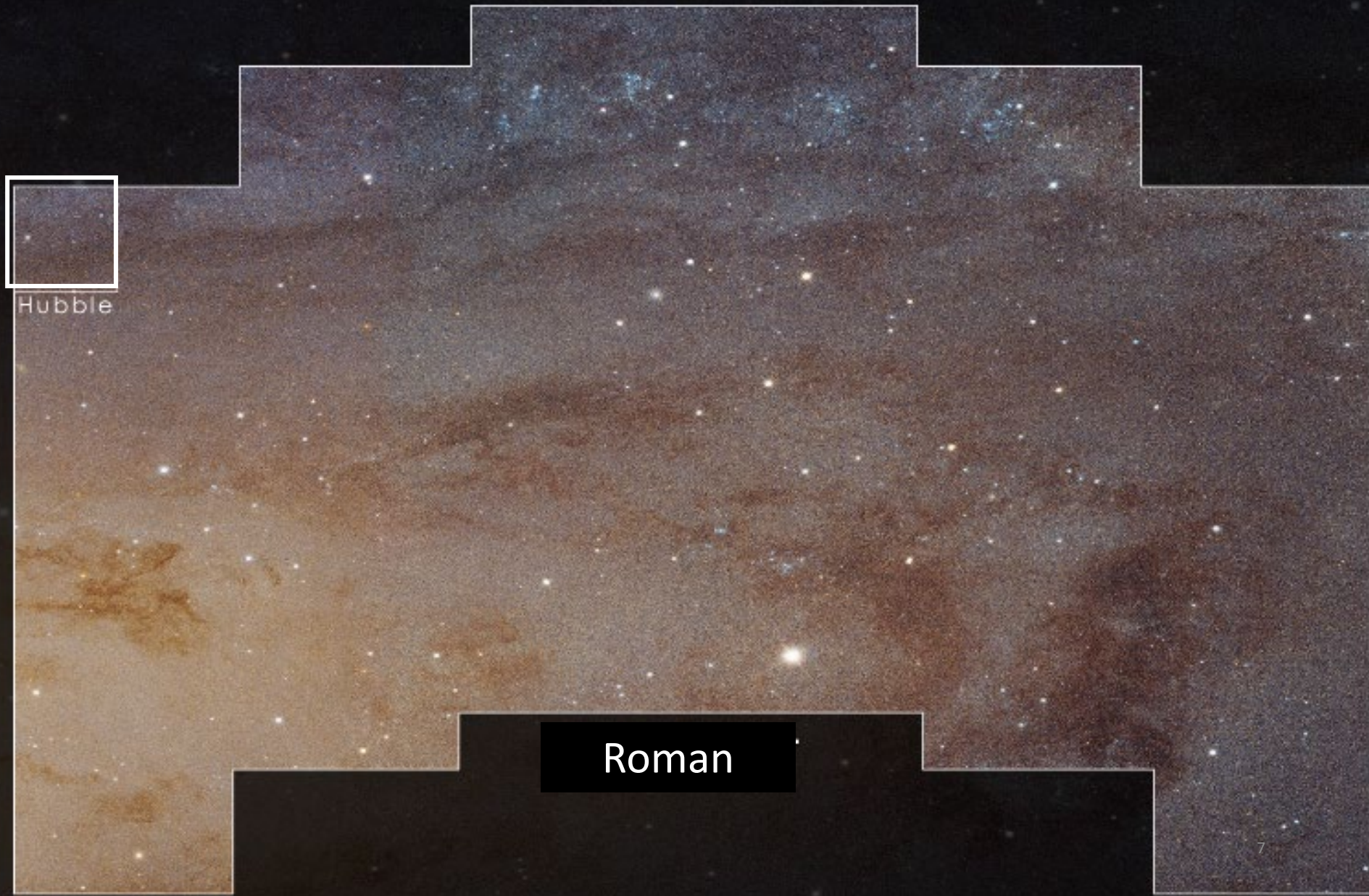


Exoplanets

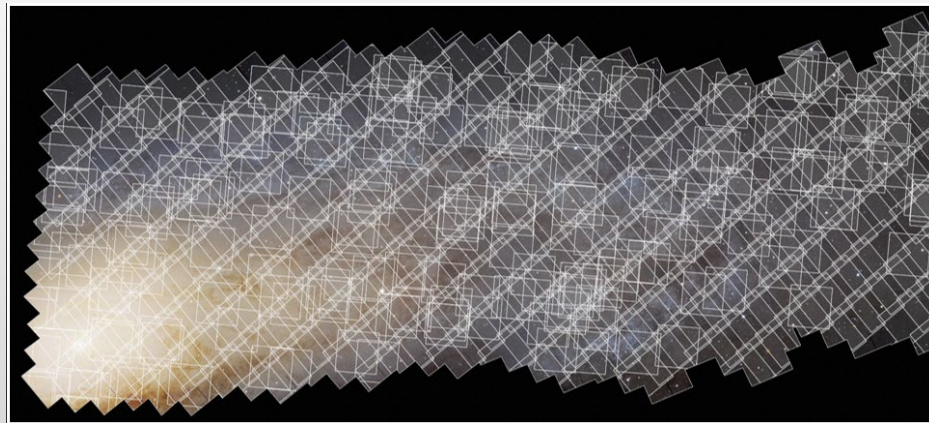
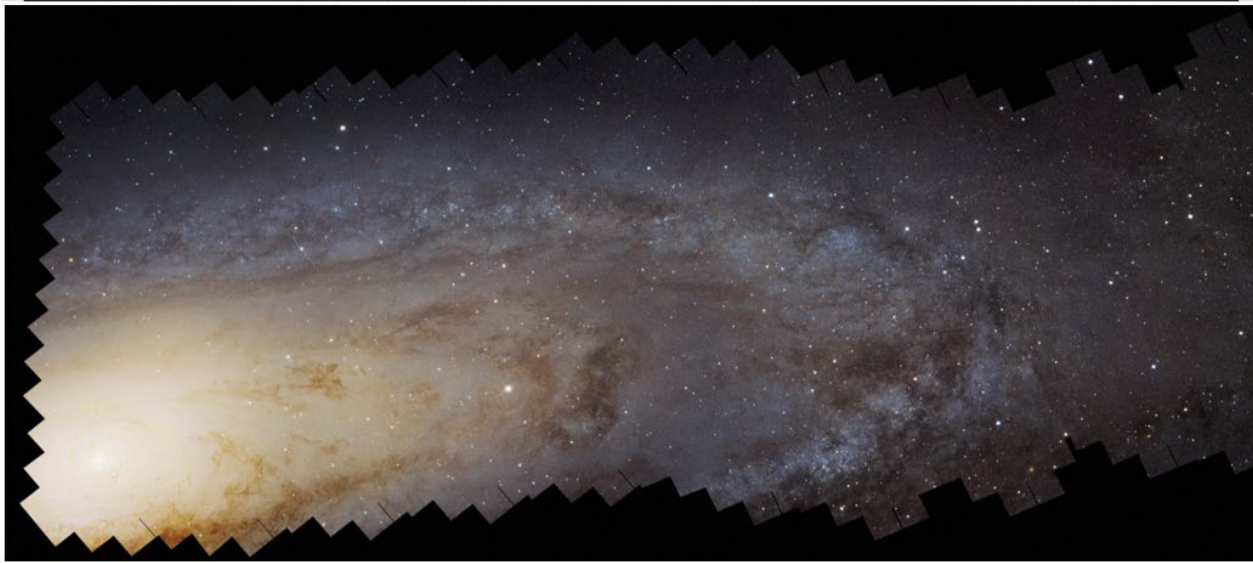


- Use 3 different methods to determine cosmic expansion history
- Enables tests of theories of accelerated expansion including Dark Energy
- Expand census of exoplanets (outer habitable zone to free floating, > Mars Mass)
- Conduct Near Infrared (NIR) imaging and spectroscopic surveys
- General Astrophysics: Provide General Observer (GO) and Guest Investigator Programs for the community
- Technology Demonstration Objective: Demonstrate exoplanet coronagraphy with active wavefront control

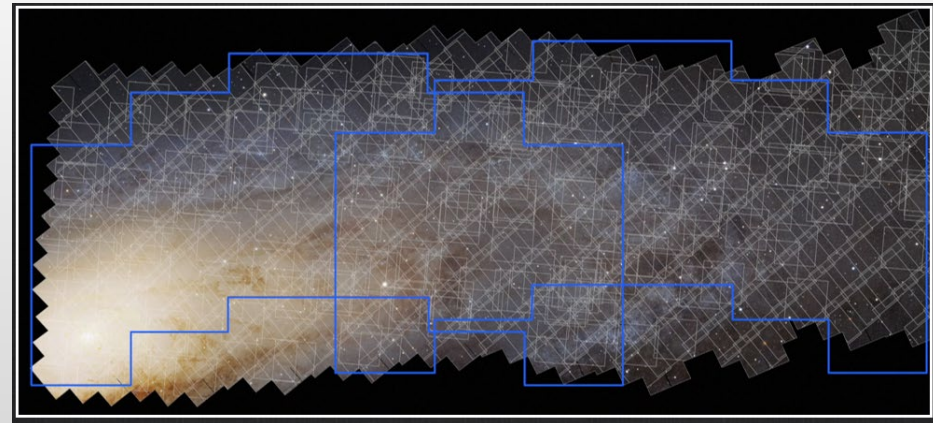
Roman Space Telescope overview



Roman Space Telescope overview: Andromeda galaxy

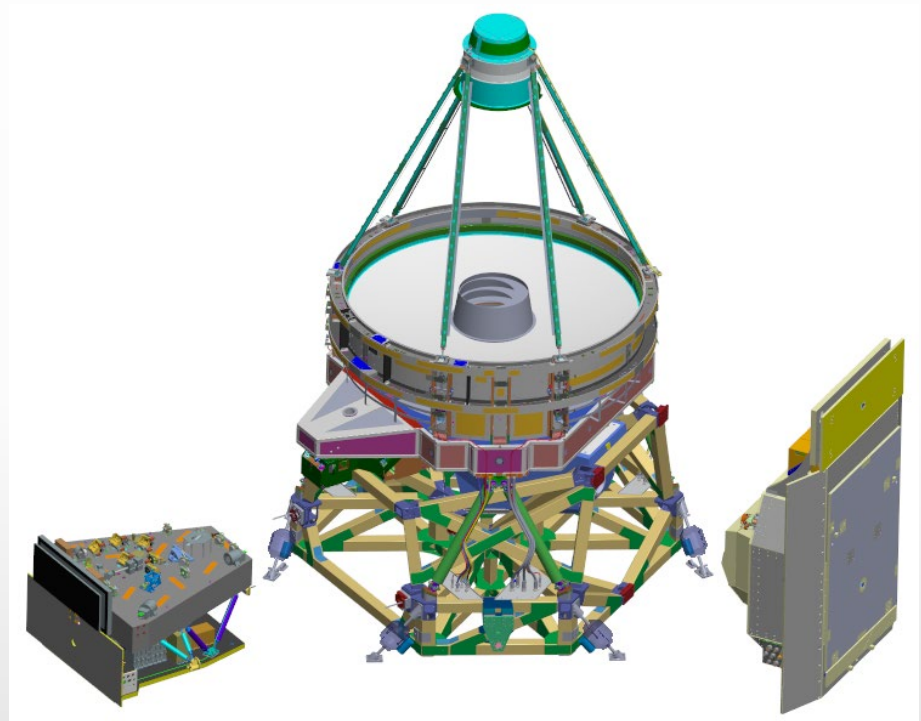
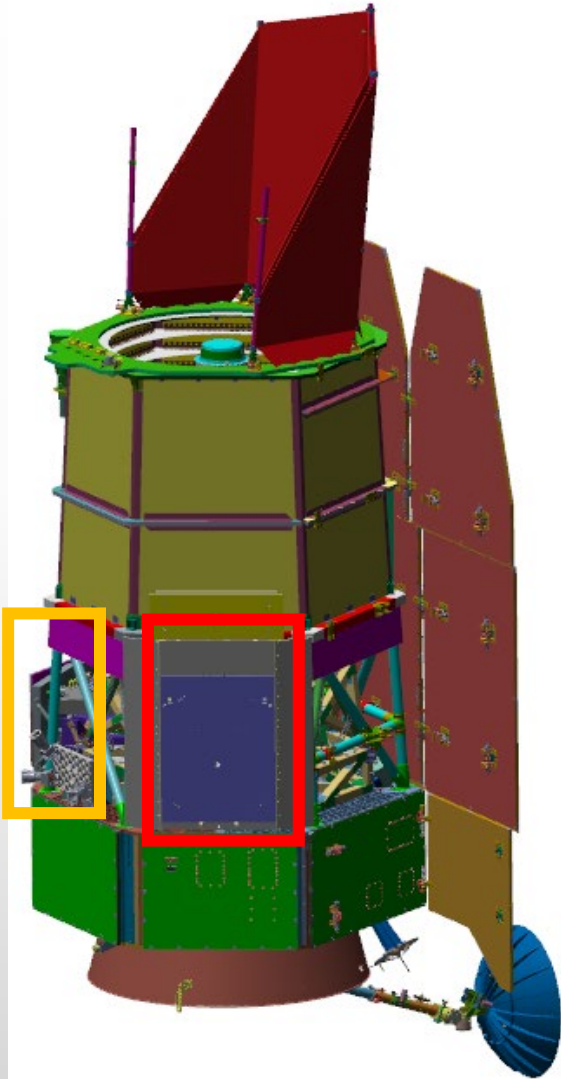


Hubble: 400+ individual pointings



Roman: 2 individual pointings

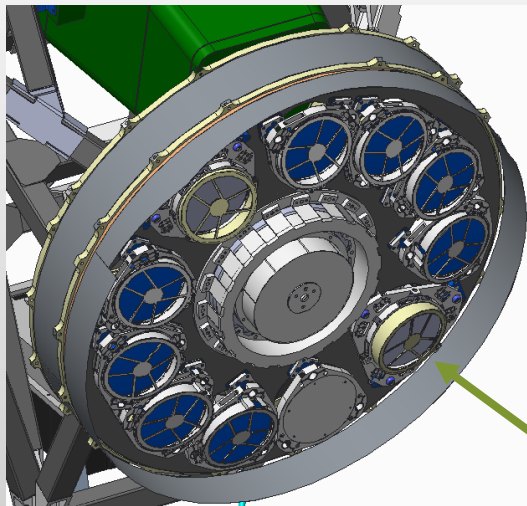
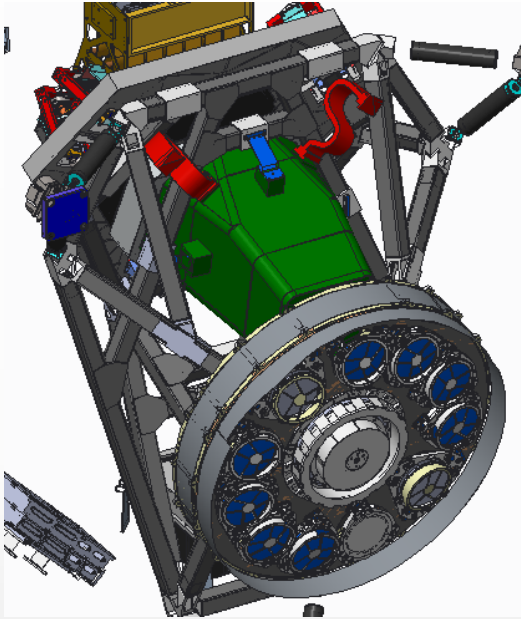
Roman Space Telescope instruments



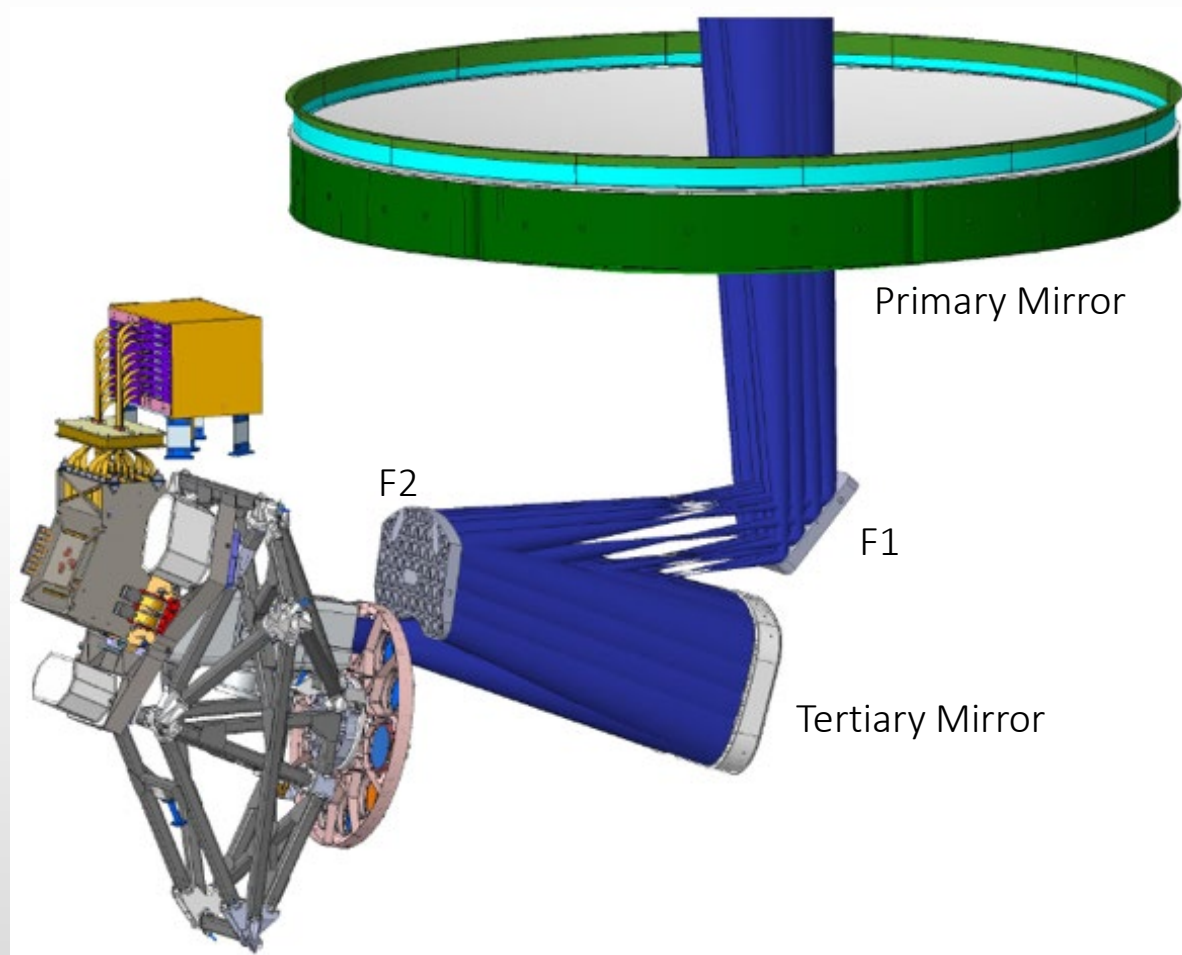
Coronagraph
Instrument
(CGI)

Wide Field
Instrument
(WFI)

Roman optical configuration: WFI and grism



Grism



Primary Mirror

F2

F1

Tertiary Mirror

Roman grism

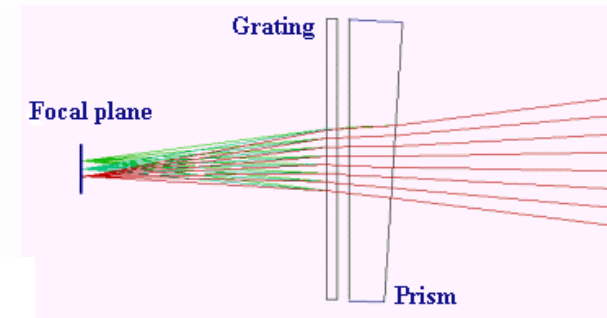
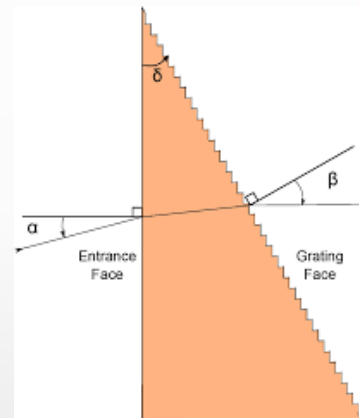
Grism: Grating prism (slitless spectrometer)

Previously used in HST instruments:

- WFC3
- NICMOS
- ACS)

Roman vs HST:

	Roman	HST
FOV	0.28 deg ²	0.0012 deg ²
Spectral resolution	R = 700	R = 130
f/#	8	11



Grism progression

Prototype



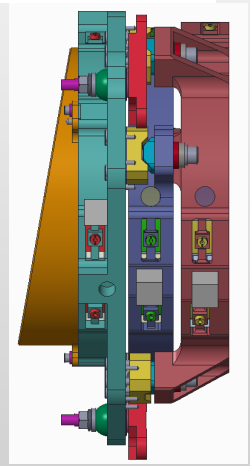
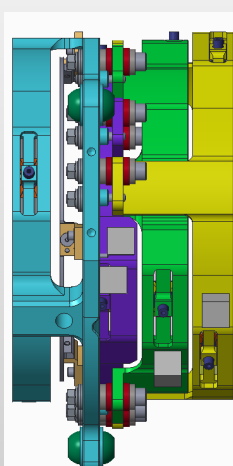
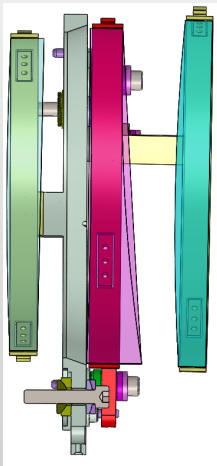
EDU



ETU



Flight



Grism progression and comparison

Prototype



EDU



ETU

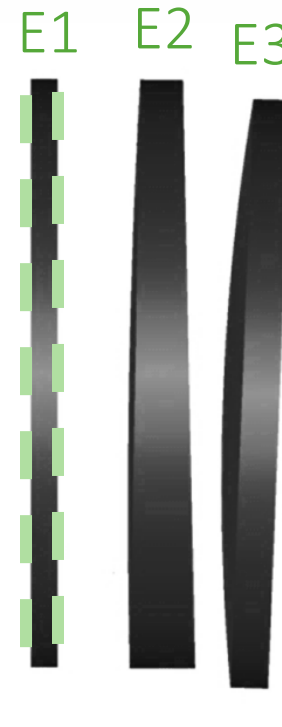
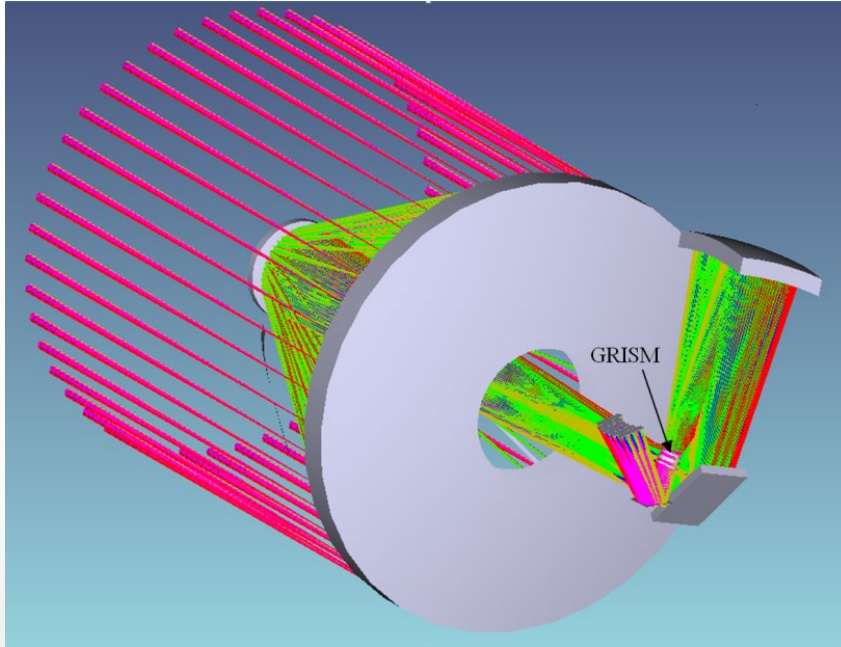


Flight



Parameters	Prototype	EDU	ETU	Flight
Wavelength range	1.35 – 1.65 μm	1.05 – 1.95 μm	1.05 – 1.95 μm	1.00 – 1.93 μm
Diffractive component	E1 and E3	E1 and E4	E1 and E4	E1
Material	Fused silica	Suprasil	Suprasil	Suprasil
Coatings	All AR coated	All AR coated	Band-pass coated E2	Band-pass coated E2

Grism Individual Elements



Element 1:

Function: diffractive on S2 provides dispersion required by the redshift emission line galaxies survey. Diffractive on S1 corrects the wavelength scaled aberration from the diffractive in non-collimated space.

Plane- parallel –plane.

Element 2:

Function: deviate the beam to make GRISM zero deviation.

Both S1 and S2 are spheres and its wedged.

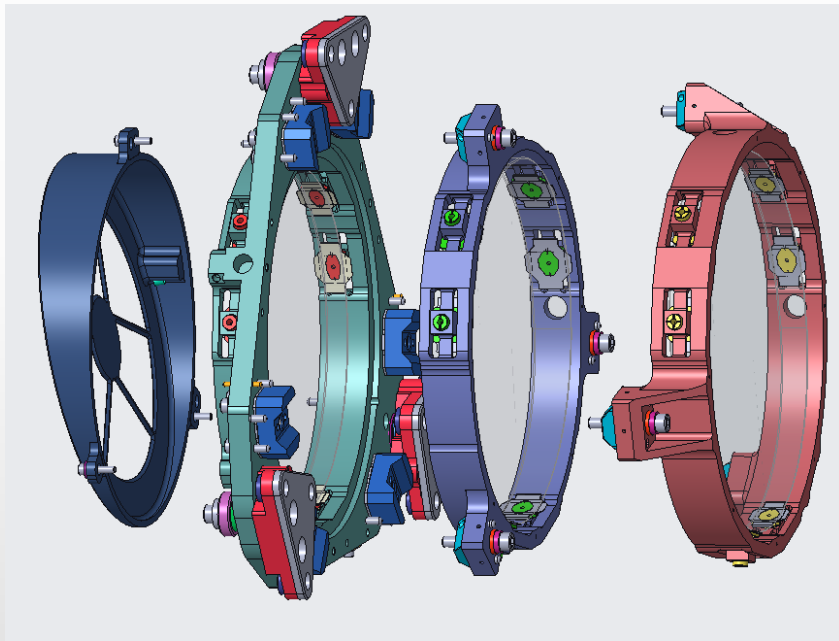
Element 3:

Function: correct the aberrations introduced by Element 2.

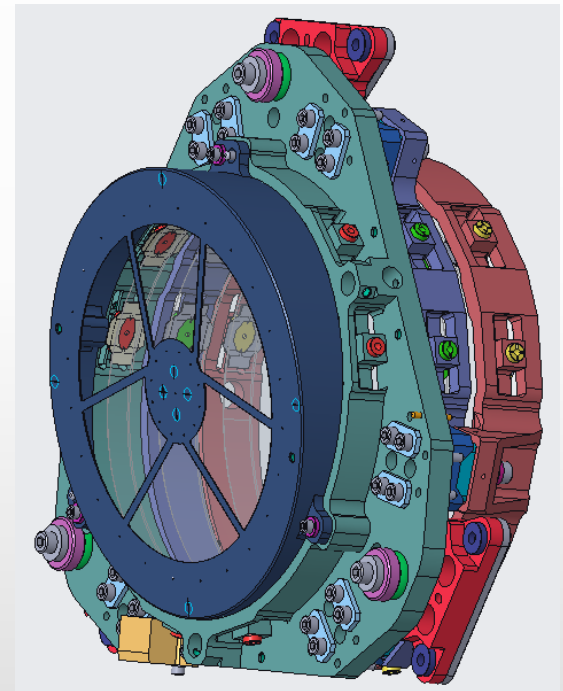
Both S1 and S2 are spheres and its wedged.

Building the grism

Individual elements



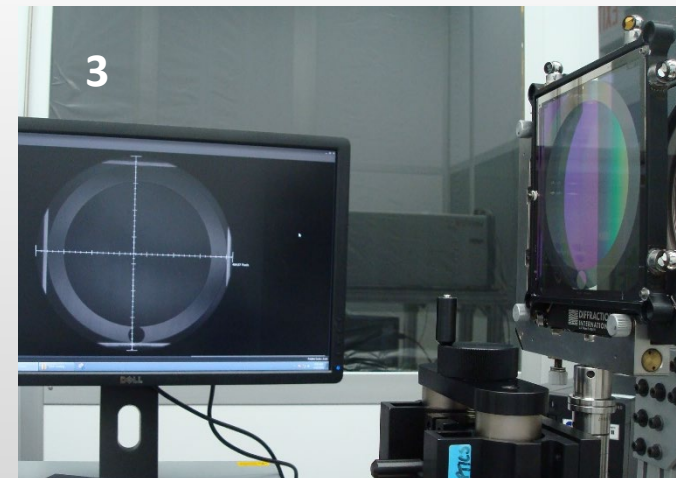
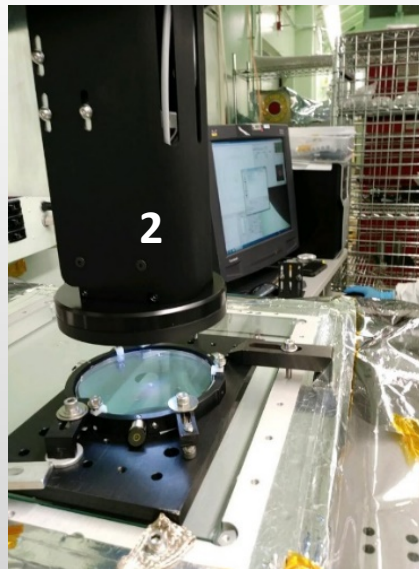
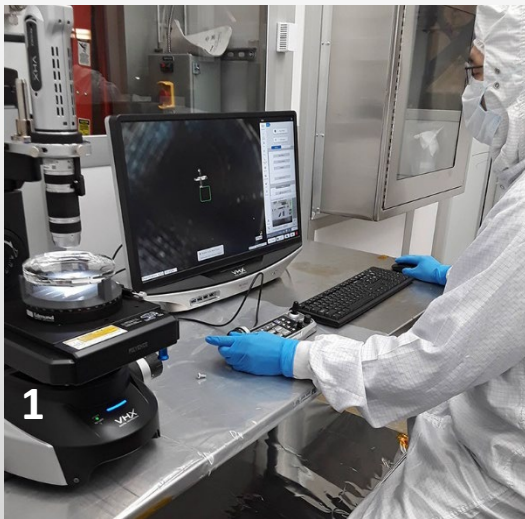
Assembly



Grism Individual Element Inspection and Characterization

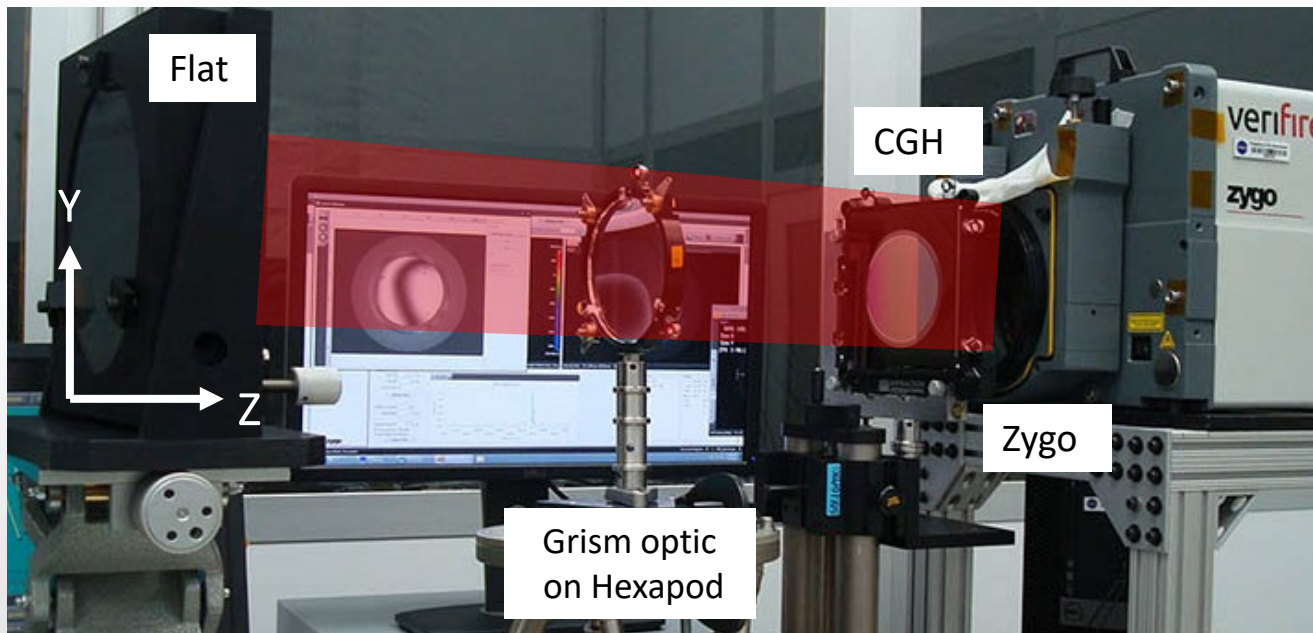
Upon receipt of the individual grism optics from the manufacturer they are:

- 1) Inspected under a microscope to verify requirements: bevel size, chips, scratches, contaminants.
- 2) Placed in their GSE Lollipop mount (LPM) and characterized under the micro-vu to establish a relationship between the fiducials, integral flats and tie point targets and cubes on the LPM. The Computer Generated Holograms (CGHs) are also characterized with the micro-vu.
- 3) Measured with their CGHs.



Grism Individual Element CGH Test Layout

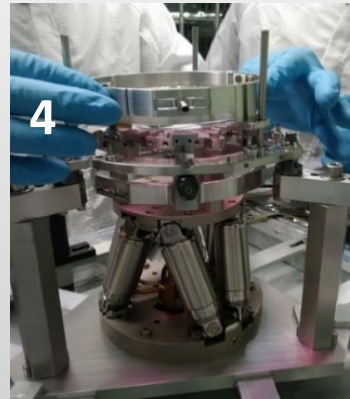
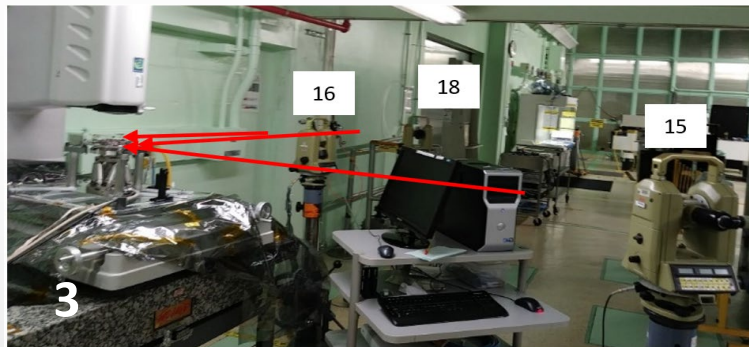
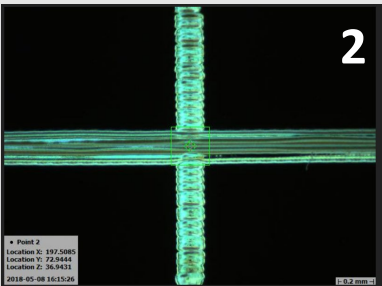
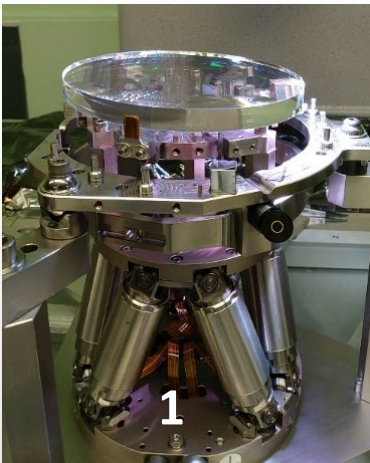
To test the individual element performance each element must have a specific CGH. A retro flat is placed at the end of the cavity to allow for a double-pass system and a theodolite and tracker must be used to measure the placement of the element with respect to its CGH.



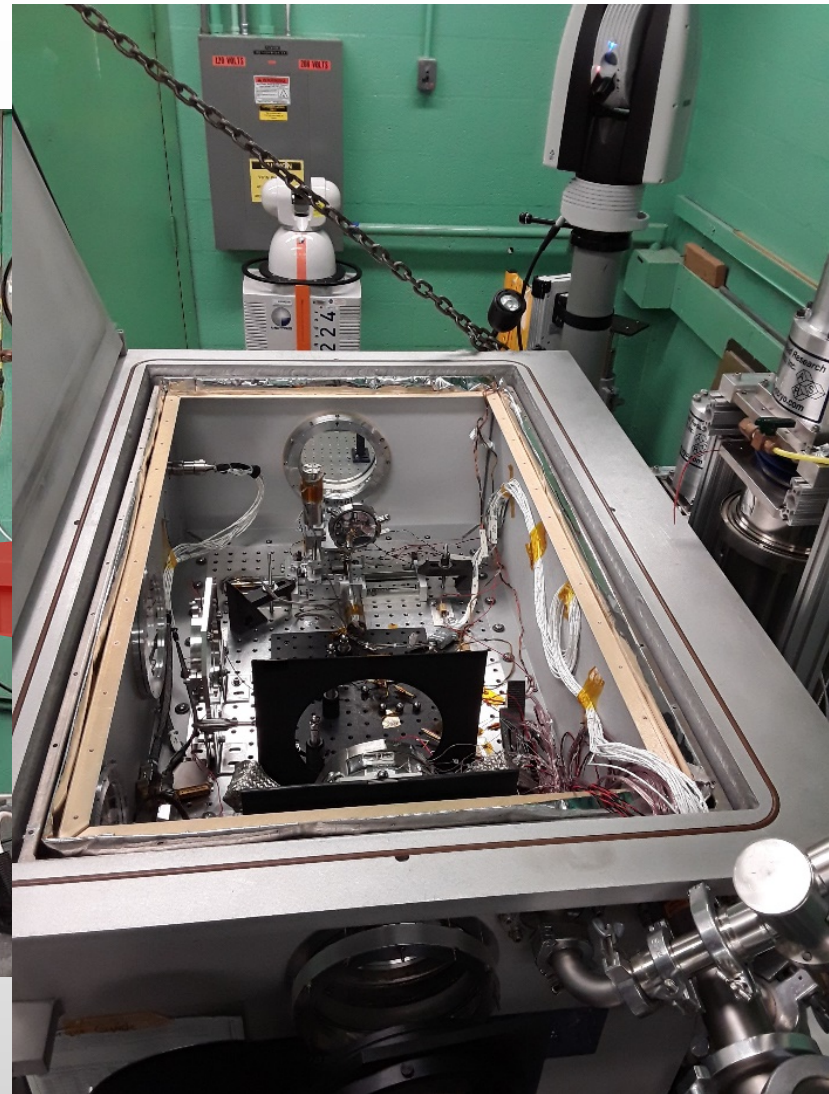
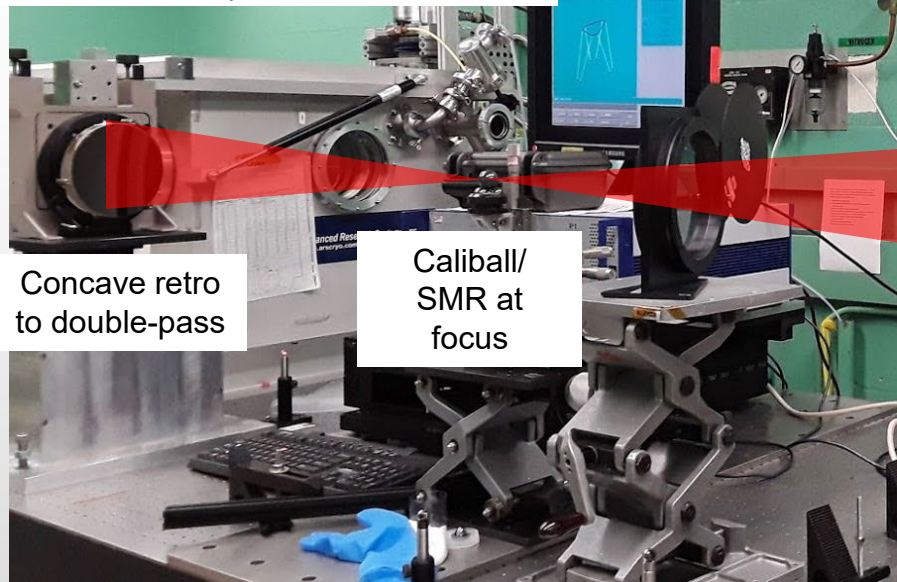
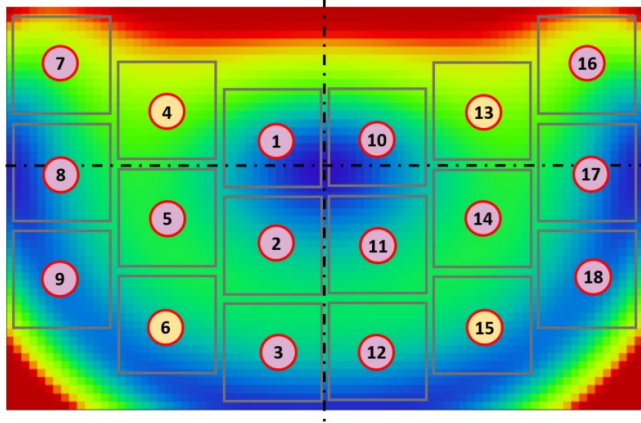
- Interferometer provides a collimated beam.
- CGH sits in collimated space.
- Use focus carrier to compensate the power of the elements.
- Tilt angle of the return mirror is different for each element.

Grism Element Alignment and Bonding

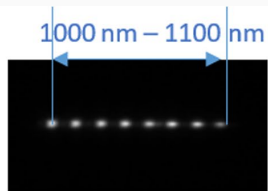
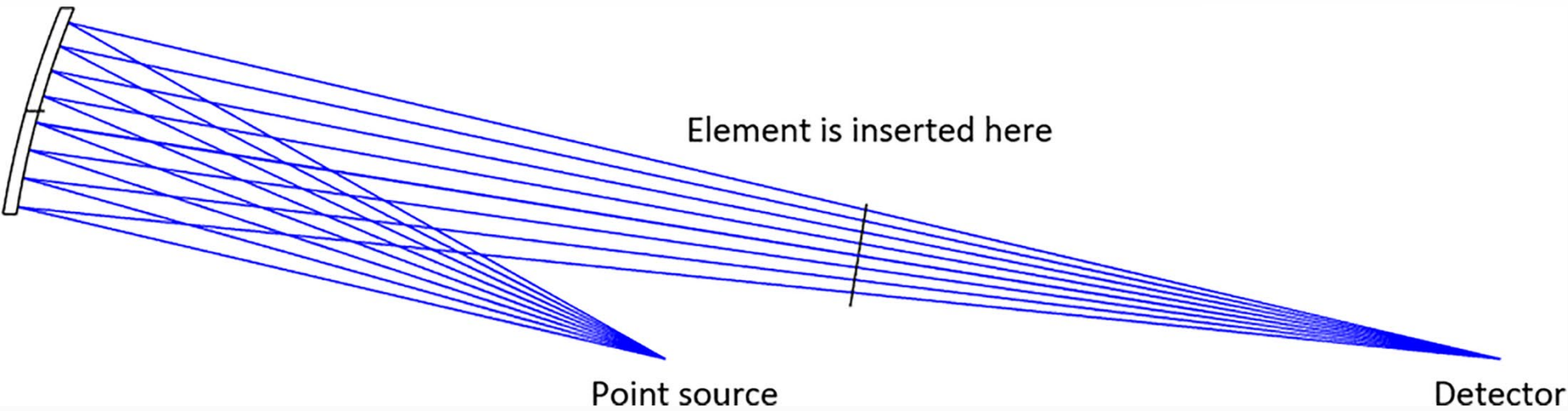
1. Place optic on hexapod without deck on the grapppler.
2. Using the micro-vu, look for the center and edge fiducials to set XYZ placement.
3. For E2 and E3 use the side integral flats measure tip/tilt and clocking (using theodolites). For E1 and E4 add a relay mirror over the optic to measure tip/tilt (using theodolites).
4. Slide cell over optic and verify and measure with the Micro-vu that it did not move.
5. Inject epoxy and let cure for five days.



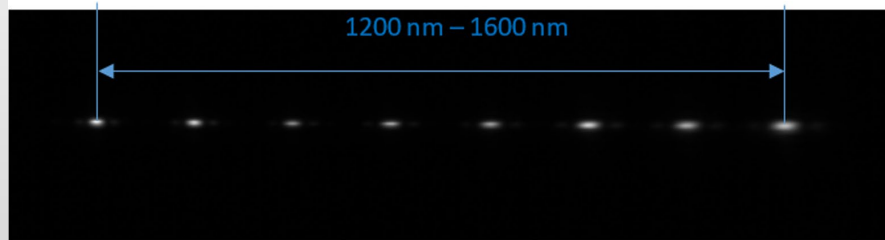
Grism Full Field WFE Mapping at ambient and cryogenic conditions



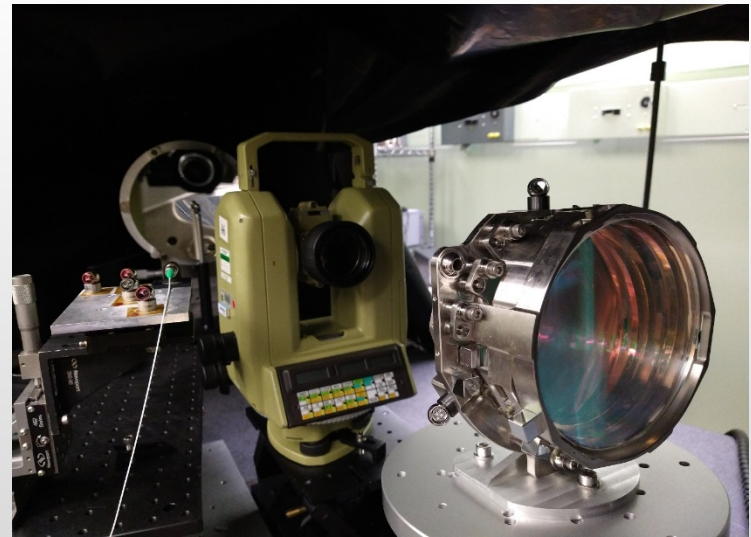
Grism dispersion testing



(a)

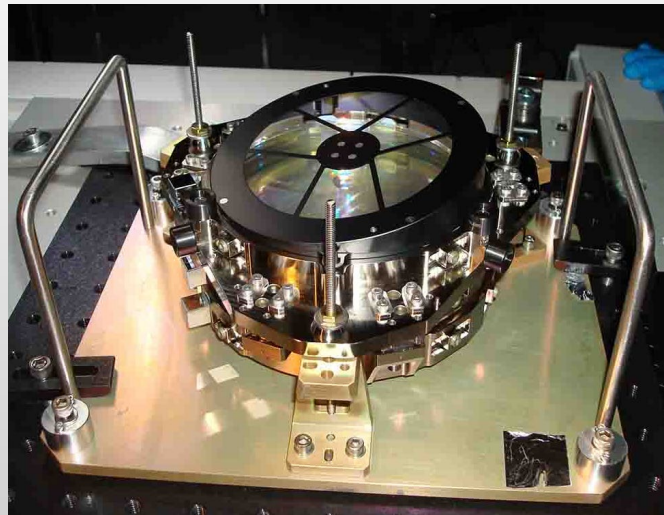


(b)



Summary

- Grism ETU demonstrates we can deliver a Flight Grism to the required specifications.
- The elements can be realigned to meet the WFE and BFL tolerances and can initially be aligned within capture range of interferometric optimization.
- The opto-mechanical design is athermal and can meet requirements at cold operational temperature, including the thermal gradient.
- We are currently completing the flight Grism and will be ready to be delivered in June 2022.



Thank you!

Contributors:

Evan Bray, John Chambers, Jenny Chu, Wes Fincher, Qian Gong,
John Hagopian, Charles He, Esben Jepsen, Brian Kittle, Jason
Krom, Bill Green, Cathy Marx, Joe McMann, Hume Peabody,
Sharon Peabody, Jacob Rosenthal, Laurie Seide, Patrick Williams